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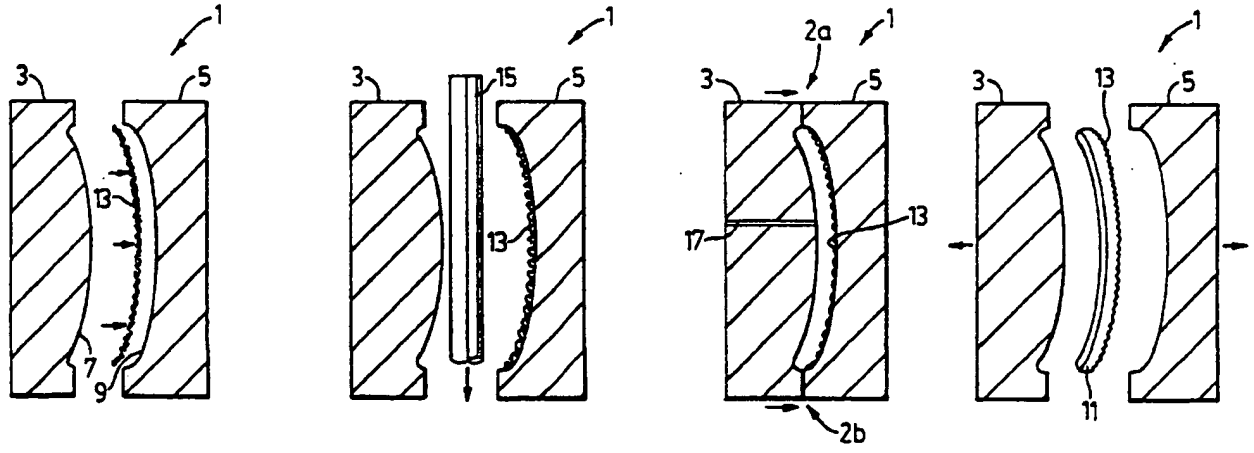
(54) Title: COMPOSITE MOLDED OBJECTS AND PROCESS



(57) Abstract

A process for molding composite plastic objects. In one version, a reinforcing mesh (13) of high tensile strength is laid on an inside surface (9) of a mold (5). A parison (15) is introduced into the mold or blown to force its thermoplastic through the mesh against the inside surface of the mold, embedding and mechanically interlocking the mesh into the thermoplastic wall of the blow molded object (11). The resultant strength increase, with little weigh increase and no adverse effect on material properties, is useful for automotive structures such as bumpers, seats and gasoline tanks. In another version, carpet or fabric having an impermeable backing is laid on a mold surface, followed by blow molding to mold and mechanically interlock the rear of the carpet or fabric into the molded structure. The resultant surfaced structure is useful in auto door panels and other applications where a decorative or textile surface finish is needed for a plastic molded structure.

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Title: COMPOSITE MOLDED OBJECTS AND PROCESS

FIELD OF THE INVENTION

This invention relates to molded objects made of two layers, namely a first layer of thermoplastic material and a second layer of different material embedded therein, and to a molding process for making such molded objects.

BACKGROUND OF THE INVENTION

In blow molding a plastic object, a mold of a desired shape is provided. A parison of suitable thermoplastic is placed in the mold; the mold is closed, and air under high pressure is blown into the parison to produce an object having said desired shape. An example of a blow mold is illustrated in Canadian Patent No. 1278660. Blow molded objects are of a wide variety, from toys to bottles to automotive parts, because the process is relatively simple and inexpensive. An added advantage of blow molded plastic automotive parts is their light weight as compared to the same parts made of metal. Furthermore, unlike metal parts, plastic parts will not rust.

Unfortunately, the full potential of blow molded plastic objects has not been exploited since they are too flexible for many uses. Hence, the plastic object must be made significantly thicker or larger than its metal counterpart to provide comparable stiffness. An alternative would be to use a stiffer plastic material, but this tends to make the object more brittle in cold temperatures, and therefore susceptible to shattering if impacted.

Where blow molded plastic objects are used for automotive parts, such as for interior automotive door panels, the objects are frequently upholstered with a carpet to provide a desired interior finish for the

automobile. The carpet must be fastened to the plastic object using an adhesive, staples, rivets or the like, thus increasing the manufacturing costs of the object. Another disadvantage is that the carpet may separate from the object with use or if an inappropriate fastener is used.

It is therefore desired to provide a molded plastic object, and a process for producing same, wherein the object is reinforced in a simple manner to enhance its stiffness without the need for increasing the object's size or providing a stiffer but more brittle plastic. Where the object is to have a carpeted surface, such as an interior automotive door panel, it is desired that the carpet's backing be mechanically bonded or interlocked with a surface of the molded plastic object to provide a carpeted object of one-piece construction.

SUMMARY OF THE INVENTION

In one aspect the invention provides a process for molding reinforced thermoplastic objects comprising:

(1) positioning at least one layer of reinforcing strands of high tensile strength on at least one inside surface of a mold;

(2) introducing a thermoplastic polymer material in a heated plastic state into the mold;

(3) forming said polymer material in said mold into a molded object and concurrently therewith causing said material to envelop said strands thus to mechanically interlock said strands and said polymer material; and

(4) opening the mold and discharging the object so molded.

In another aspect of the invention, the invention provides a process for molding a composite structure, comprising:

(1) selecting a piece of substantially impermeable surfacing material having a rear surface having surface irregularities, and a front surface;

(2) positioning said surfacing material on at lease one inside surface of a mold with said rear surface facing the interior of said mold;

(3) introducing a thermoplastic polymer material in a heated plastic state into said mold;

(4) forming said thermoplastic material in said mold into a molded object and concurrently forcing said thermoplastic material against and into said rear surface of said surfacing material to mechanically interlock said surfacing material to said molded object; and

(5) opening said mold and discharging said molded object, with said front surface of said surfacing material forming at least a portion of the exterior of said composite structure.

In a preferred embodiment of said process, said surfacing material is a carpet, and said molded object is a portion of an interior automotive panel.

In yet another aspect the invention provides a reinforced sheet of thermoplastic material comprising:

(1) a continuous layer of said thermoplastic material; and

(2) at least one layer of reinforcing strands of high tensile strength embedded in and

adjacent at least one surface of said layer of thermoplastic material, said strands being covered by said thermoplastic material.

In a further aspect the invention provides a composite thermoplastic structure comprising:

(1) a continuous layer of thermoplastic material;

(2) a piece of surfacing material having a rear surface having surface irregularity, and a front surface; and

(3) said thermoplastic material being molded into and mechanically interlocked with said rear surface, said front surface forming at least a portion of the exterior of said structure.

In a preferred embodiment of said composite thermoplastic structure, the composite structure comprises at least a portion of an automotive inside door panel and said surfacing material is carpet.

DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the present invention are described below with reference to the accompanying drawings in which:

Figure 1 is a cross sectional view through a mold showing four stages of a blow molding process according to the present invention;

Figure 2 is a perspective view of a mesh for use in the process of Figure 1;

Figure 3 is a perspective view of a piece of a reinforced thermoplastic material from the process of Figure 1;

Figure 4 shows a graph wherein the vertical axis represents the force (in pounds) applied to three strips

of reinforced thermoplastic material according to the present invention and to a strip of said material without any reinforcement, and the horizontal axis represents the corresponding deflections (in inches) of said strips;

Figure 5 is a view from the front of an automotive bumper produced according to the present invention;

Figure 6 is a perspective view of a section of the automotive bumper of Figure 5 and a close-up of a strip of reinforcement in said bumper;

Figure 7 is a perspective view, as seen from the bottom, of an automotive gasoline tank according to the present invention;

Figure 8 is a cut-away perspective view of a seat back according to the present invention;

Figure 9 is a sectional view of a mold showing another molding process according to the invention;

Figure 10 shows a composite molded structure resulting from the Figure 10 process;

Figure 11 is a sectional view of another mold showing a molding process according to the invention; and

Figure 12 shows a composite molded structure resulting from the Figure 11 process.

DESCRIPTION OF PREFERRED EMBODIMENTS

Reference is first made to Figure 1 which shows a cross section of a mold 1 in various stages of a blow molding process, starting at Figure 1 (a) and progressing to Figure 1 (d). The mold 1 is of usual construction, having a left portion 3 and a right portion 5. The left and right portions 3, 5 have left and right inside surfaces 7, 9, respectively, which provide the external shape of a reinforced thermoplastic object 11 to be produced by the mold 1.

The process for molding the object 11 according to a preferred embodiment of the present invention comprises positioning a layer of reinforcing strands or mesh 13 of high tensile strength on the right inside surface 9 as shown in Figure 1 (a). The strands 13 may be arranged in a grid, and in the preferred embodiment the strands 13 comprise a flexible woven wire mesh as shown in Fig. 2. Ordinary wire window screen is a suitable mesh. Good results may also be achieved using strands or a woven mesh of polyester and nylon with high tensile strength. Again, mesh in the form of a conventional window screen is suitable. In very high strength applications, strands of material known as Kevlar (trade mark), woven into a mesh, can be used. The mesh material must not, of course, melt at the temperature used in the molding process.

The mesh 13 may be preformed or may be pressed against one of the mold inside surfaces, e.g. against the right inside surface 9, to adopt a similar or identical profile as that of the surface 9. One or more layers of mesh 13 may be used. Likewise, one or more layers of the mesh 13 may be positioned on the left inside surface 7.

Once the mesh 13 is in place, a parison 15 of suitable molding material, such as a thermoplastic material, is introduced into the mold 1 between the left and right inside surfaces 7, 9 as shown in Figure 1 (b). The parison 15 may be in the form of an elongate hollow tube, the desired thickness of the tube wall being controlled by an outlet opening of a device which feeds the parison into the mold (not shown). The mold 1 is then closed, and top and bottom ends 2a, 2b of the mold 1 pinch the parison 15 (Figure 1 (c)). The parison is "blown" in a known manner by introducing air or other desired gas into the hollow centre of the parison 15. The air is injected into the mold 1 and into the parison 15 through one or more openings or needles 17 in the mold,

which is usually cooled using water or by other suitable means. The needle 17 may be provided at any convenient spot in the mold 1. The air pressure forces the polymer material outwardly toward the inside surfaces 7, 9, thereby pressing the mesh 13 against the right inside surface 9. The pressure forces the polymer material through the mesh 13 and around each strand of the mesh 13, thereby surrounding each strand of mesh 13 with the polymer material.

Once the polymer material sets, usually in 15 to 30 seconds depending on the polymer material used and the size of the molded object, the mold 1 is opened and the molded object 11 is removed (Figure 1 (d)). The molded object 11 will have a hollow core if the parison 15 is blown. The exterior surface 19 of the molded object 11 will normally be smooth to the touch since the mesh is embedded just beneath the surface 19. As shown in Fig. 3, there will be a thin continuous coating 20 of polymer material between the mesh 13 and the exterior surface 19. It will be appreciated that if the parison is insufficiently heated prior to introduction into the mold or if insufficient pressure is applied in the blow molding process, then the mesh 13 may not be completely covered resulting in discontinuities in the exterior surface 19 which can expose the mesh to corrosive agents from the surroundings.

To demonstrate the improved qualities of the reinforced molded object 11 produced by the molding process of the present invention, three thermoplastic molded objects 11 were produced in the form of reinforced sheets or longitudinal strips of equal width. The first sheet comprised a continuous layer of thermoplastic material and one layer of reinforcing wire mesh 13 embedded in and adjacent a first exterior surface of the sheet. The second and third sheets were identical to the

first sheet except for additional second and third layers of reinforcing wire mesh placed adjacent the first layer, respectively (so that the wire mesh was two and three layers thick). A fourth "control" sheet with identical dimensions was produced but omitting the reinforcing wire mesh. Each of the four sheets was tested in a horizontal position and supported at each end. The first exterior surface (ie. the surface to which the mesh was closest) was oriented downwardly. A force of three pounds was applied to the opposite (ie. top) surface of each sheet at its centre line between the supports and the deflection of each sheet at said centre line was measured.

The results are presented in the graph of Figure 4. The deflection of the control sheet was about .055 inches (0.139 cm) as shown at 21-0 whereas the deflection of the first sheet with the single reinforcing layer was reduced to about .04 inches (0.102 cm) as shown at 21-1, a decrease of about 27%. The deflections of the second and third sheets were reduced further, to about .035 inches (0.089 cm) and .029 inches (0.074 cm) respectively, as shown at 21-2 and 21-3. Hence, the deflection of these sheets was reduced significantly (or, conversely, the stiffness was increased) as compared to the control sheet. This was accomplished with a negligible increase in the weight of the sheets. In addition, the cost of the mesh 13 is very low, and the properties of the thermoplastic material are not adversely affected.

It is noted that the mesh 13 itself is normally very flexible. However when it is embedded in the thermoplastic material, its strands are locked in place, and since any bending movement then tends to stretch the strands, such bending movement is strongly resisted. When the mesh 13 is woven, with its strands running in two directions at right angles to each other as shown, then resistance to bending is enhanced. There is no need to

introduce special fibres into the thermoplastic material; the mesh 13 is very easy to lay in place. There is no need for special compatibility between the mesh 13 and the thermoplastic material since the mesh is essentially mechanically held in place.

While the method described employs blow molding, it is also possible to perform the process using similar techniques, such as vacuum molding.

The embodiments of the present invention so far described finds numerous uses, some of which are shown in Figures 5 to 8. Primed numerals are used to identify like elements from the first embodiment in Figures 1 to 3.

The process of the present invention may be used to produce a hollow reinforced bumper 21 for automobiles as shown in Figures 5 and 6. Prior art "plastic" bumpers comprise a plastic "facial" surrounding a metal bumper frame. Until now entirely plastic bumpers have been too flexible and have not demonstrated the required deflection control to protect against even relatively minor impacts. Hence, the costly (and relatively heavy) metal frames must be inserted to provide the bumper with the necessary stiffness to absorb impacts.

A bumper body 23 made according to the present invention is blow molded of a thermoplastic polymer having a B-shape in cross section (Figure 5) and two strips of reinforcing mesh 13' embedded in the outwardly curved portions of the B to stiffen the bumper 21 (it is understood that the strips 13' appear exposed in the figures for illustrative purposes only). An advantage of the bumper 21 is that it is stiff enough to adequately control deflections, yet the bumper 21 is flexible enough to absorb impacts without permanently deforming the bumper body 23. The bumper 21 weighs less than prior art bumpers and the cost of the polymer material is much less than that of prior bumpers which have metal frames. It will be

appreciated that a greater proportion of the bumper body 23 may employ the mesh 13' or several layers may be used to increase stiffness if need be. The mesh 13 may be of any desired gauge and strength of metal strands, or of plastic strands of suitable tensile strength, as discussed. Bolts 25 used to attach the bumper 21 to the automobile's chassis may be embedded in the bumper body 23 by inserting the bolts 25 into the mold 1 during the molding process.

Figure 7 shows the use of the present invention in an automotive gasoline tank 27. The tank 27 has a base 29 and front and back walls 31, 33 respectively. Such tanks are commonly made of polyethylene for its strength and solvent resistance properties. Since tank bases have a relatively large surface area and are subjected to heavy loads (especially when the tank is full of gasoline), the bases must be supported to prevent excessive deflections or sag. Prior art tank bases are particularly susceptible to excessive sag when the polyethylene base is heated up by hot road surfaces or the like. Hence the practice in the automobile industry has been to support the base with two or more spaced metal ribs (which are part of the vehicle). These ribs tend to be heavy and are susceptible to corrosion.

The gasoline tank 27 of the present invention is blow molded, and where the metal ribs would support the base 29, there are two spaced strips of wire or plastic mesh 13'. The strips 13' extend transversely across the base 29 and at least partway up the front and back walls 31, 33. In this embodiment the mesh 13' is again embedded adjacent the outside surface of the base 29 during the molding process. One or more strips and layers of mesh 13' may be provided depending on the stiffness required and the amount of load to be transferred to the front and back walls 31, 33. As with the bumper 21 discussed above, advantages of replacing the prior art ribs with the mesh

strips in the tank 27 are the savings in cost and weight of materials used. In addition, the cost of installing the metal ribs in the automotive body is eliminated.

In an alternate embodiment of the gasoline tank, the entire body 28 of the gasoline tank 27 is lined with the mesh 13'. Such a configuration may be applied to other blow molded containers for different liquids. This is accomplished by lining the entire interior surface of the mold with mesh before inserting and blowing the parison. An advantage of this configuration over prior art containers molded of the polymer material alone is that the permeation by liquids through the polymer material is reduced by up to 30%. This reduction in permeation is attributed partly to reduced expansion of the polymer material itself due to the resistance to expansion provided by said mesh, and partly to the reduced penetrable surface area of polymer material between the inside and the outside of the container (since the mesh may typically occupy about 20% of the surface area).

Figure 8 shows a blow molded seat back support 35 of the present invention. A common drawback of prior art seat back supports is excessive flex, leading to back pain and discomfort of the user. An inexpensive method of stiffening such seat back supports 35 to reduce flex is the addition of one or more wire mesh strips 13' adjacent the outside surface 37 of the seat back support (ie. adjacent the surface which is in contact with the user). The quantity of wire mesh 13' provided depends on the desired stiffness of the seat back.

In yet another embodiment of the invention, as shown in Fig. 9, a piece 50 of carpet, fabric, or the like can be used to line a section of a mold 52. The carpet or fabric 50 has a backing 50-1 and a pile 50-2. A layer of hot thermoplastic 54 is then blown or forced into the mold 52, over the carpet or fabric 50. The hot plastic 54,

which is semi-molten, fuses into the backing 50-1. This produces a one-piece structure 56 as shown in Fig. 10, with a carpet or fabric facing 58.

An alternative arrangement is shown in Fig. 11(a), in which carpet or fabric 50 lines one side of a blow mold 60. If a carpet 50 is used, then it is placed with the pile adjacent the inside surface of the mold 60 (as shown in Fig. 9). When the mold is closed to pinch the parison 62 and the parison 62 is blown (Fig. 11(b)), the mold 60 is opened and a structure 64 results. Structure 64 can be, for example, an automotive door panel as shown in Figure 12 with the surface 66 which faces the interior of the vehicle suitably upholstered. This eliminates the current need for an extra step to attach an upholstery layer to a panel mechanically or by adhesive. The carpet or fabric can be held in place in the mold by any suitable means. For example suction may be applied through passages 68 if there is little or no pile 50-2 and the carpet backing 504 is very tightly woven to create the required suction force, or by plastic ties which can be cut after the molded structure has been formed.

The thermoplastic material 54 or 62 is forced with considerable pressure against the back of the layer of carpet or fabric 50, typically 90 p.s.i. The pressure should be kept below 150 p.s.i. in order not to crush or collapse most carpets. Higher pressure might be used for relatively non-crushable carpets. Despite the pressures exerted, the thermoplastic material cannot penetrate the backing 50-1 of the carpet or fabric 50 because the backing 50-1 is formed of an impermeable material. However the rear surface of the backing 50-1 has considerable surface irregularity, so that the thermoplastic material can penetrate into the interstices of the rear surface and mechanically interlock therewith.

Suitable ranges of extruding temperatures for different thermoplastic materials to form the required interlock with a carpet backing are: approximately 380 ° - 450 ° F for polyethylene; approximately 400 ° - 450° for polypropylene; and approximately 450° - 500° F for polyolefins.

The carpet 50 may line all or sections of the mold 60. The thermoplastic material tends not to creep around the edges of the carpet 50 onto the pile 50-2 because the thermoplastic stretches radially outwardly from the center of the backing 50-1 and so it moves away from the edges of the carpet. If necessary, appropriate means, e.g. clamps, might be used to ensure that the thermoplastic material does not force its way between the edges of the carpet or fabric 50 or the mold surface.

An advantage of the present invention is that the resultant structure can be wholly recyclable. To illustrate, if both the carpet 50 and the thermoplastic 54 of the resultant structure 64 are both composed of polypropylene, then the carpet and structure may be recycled together without separating them.

Another advantage of the present invention is that the carpet 50 can reinforce any points of weakness of the structure 54. For instance, if the one part of door panel 64 in Figure 12 was integrally hinged to rotate relative to another part of the panel 64, then carpet upholstery can be bonded to the hinge to increase its durability and rotational stiffness.

If desired, a layer of foam may be added between the carpet backing 50-1 and the layer of thermoplastic material. This application is suitable, for example, where extra cushioning is required, such as for the back support of a seat. The foam must be glued or suitably attached to the carpet backing since the thermoplastic does not penetrate the foam to form any bond between the

foam and the carpet backing 50-1. In turn, the thermoplastic and the foam might not sufficiently mechanically interlock together, and so the foam should be compatible with the thermoplastic for both to chemically bond together. If extra bonding between the thermoplastic and foam is desired, then a pressure sensitive or heat sensitive adhesive (for example, polyurethane or polyester) may be provided between both.

The above description is intended in an illustrative rather than a restrictive sense and variations to the specific configuration and materials described may be apparent to skilled persons in adapting the present invention to specific applications. Such variations are intended to form part of the present invention insofar as they are within the spirit and scope of the claims below.

I CLAIM:

1. A process for molding reinforced thermoplastic objects comprising:

(1) positioning at least one layer of reinforcing strands of high tensile strength on at least one inside surface of a mold;

(2) introducing a thermoplastic polymer material in a heated plastic state into the mold;

(3) forming said polymer material in said mold into a molded object and concurrently therewith causing said material to envelop said strands thus to mechanically interlock said strands and said polymer material; and

(4) opening the mold and discharging the object so molded.

2. The process of claim 1 wherein said step of forming said material includes the step of providing said material in the form of a parison with said strands initially being located between said parison and said inside surface, and blowing said parison to force said material through said strands and against said inside surface.

3. The process of claim 1 or 2 wherein said reinforcing strands are selected from the group comprising metal and a plastic material.

4. The process of claim 1 or 2 wherein said reinforcing strands are arranged in the form of at least one layer of mesh.

5. A process for molding a composite structure, comprising:

(1) selecting a piece of substantially impermeable surfacing material having a rear surface having surface irregularities, and a front surface;

(2) positioning said surfacing material on at least one inside surface of a mold with said rear surface facing the interior of said mold;

(3) introducing a thermoplastic polymer material in a heated plastic state into said mold;

(4) forming said thermoplastic material in said mold into a molded object and concurrently forcing said thermoplastic material against and into said rear surface of said surfacing material to mechanically interlock said surfacing material to said molded object; and

(5) opening said mold and discharging said molded object, with said front surface of said surfacing material forming at least a portion of the exterior of said composite structure.

6. The process according to claim 5 wherein said step of forming is performed by applying pressurized air to said thermoplastic material.

7. The process according to claim 6 wherein said thermoplastic material is introduced into said mold in the form of a parison, with said surfacing material located between said inside surface and said parison.

8. The process according to claim 5, 6 or 7 wherein said surfacing material is carpet.

9. The process according to claim 8 wherein said molded object comprises at least a portion of an interior automotive panel.

10. The process according to claim 8 wherein a cushioning material is located between said surfacing material and said parison and chemically bonds to said parison.

11. The process according to claim 10 wherein an adhesive is located between said cushioning material and each of said surfacing material and said parison, said adhesive being selected from the group comprising pressure sensitive and heat sensitive adhesives.

12. A reinforced sheet of thermoplastic material comprising:

(1) a continuous layer of said thermoplastic material; and

(2) at least one layer of reinforcing strands of high tensile strength embedded in and adjacent at least one surface of said layer of thermoplastic material, said strands being covered by said thermoplastic material.

13. The reinforced sheet of claim 12 wherein said reinforcing strands are selected from the group comprising metal and a plastic material.

14. The reinforced sheet of claim 12 wherein each layer of reinforced strands is arranged in the form of a mesh.

15. The reinforced sheet of claim 12, 13 or 14 wherein said sheet comprises at least a portion of an automotive bumper.

16. The reinforced sheet of claim 12, 13 or 14 wherein said sheet comprises at least a portion of an automotive gasoline tank and the thermoplastic material comprises polyethylene.

17. The reinforced sheet of claim 12, 13 or 14 wherein said sheet comprises at least a portion of a seat structure.

18. The reinforced sheet of claim 12, 13 or 14 wherein said sheet comprises at least a portion of a container for liquids.

19. A composite thermoplastic structure comprising:

(1) a continuous layer of thermoplastic material;

(2) a piece of surfacing material having a rear surface having surface irregularity, and a front surface; and

(3) said thermoplastic material being molded into and mechanically interlocked with said rear surface, said front surface forming at least a portion of the exterior of said structure.

20. A composite structure according to claim 19 wherein said surfacing material is carpet.

21. A composite structure according to claim 19 or 20 and comprising at least a portion of an automotive inside door panel.

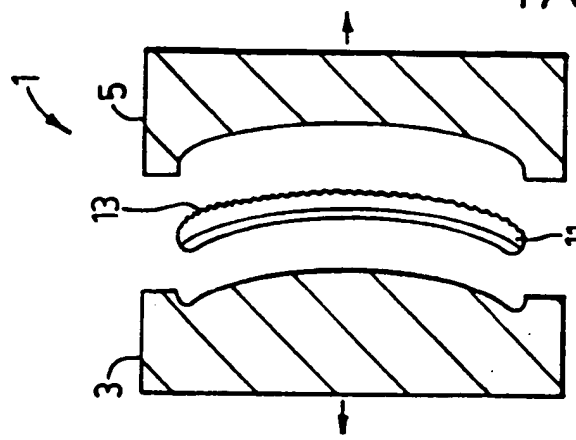

FIG. 1d

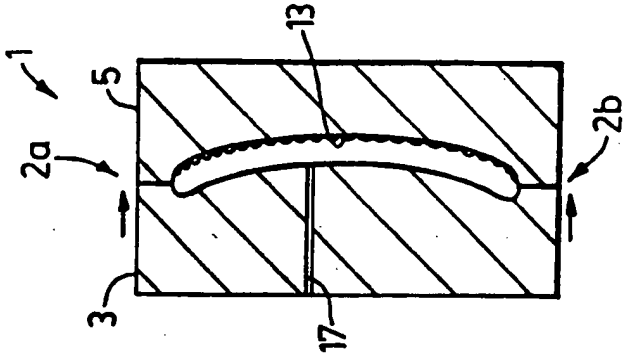

FIG. 1c

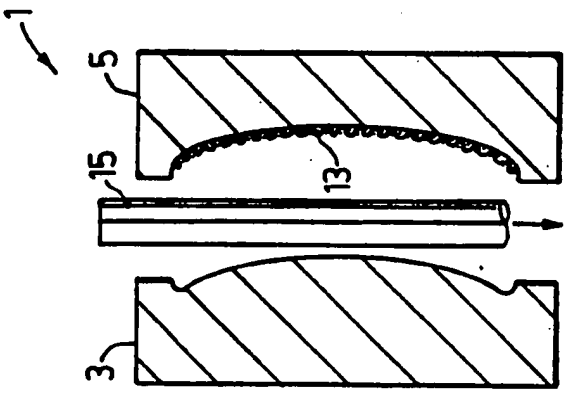

FIG. 1b

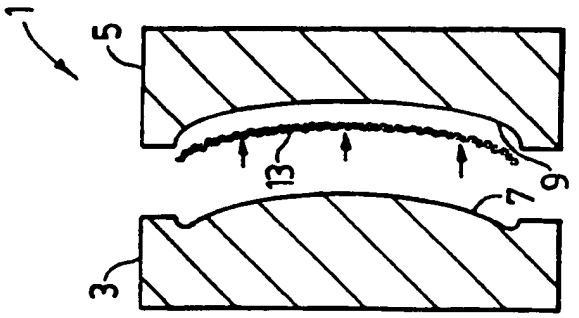

FIG. 1a

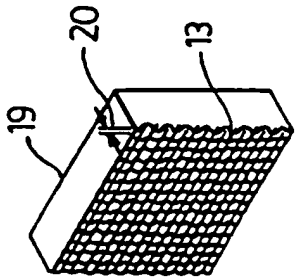

FIG. 3

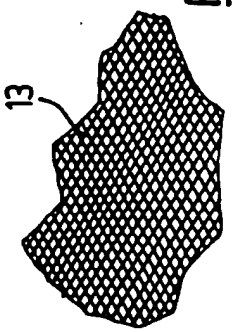

FIG. 2

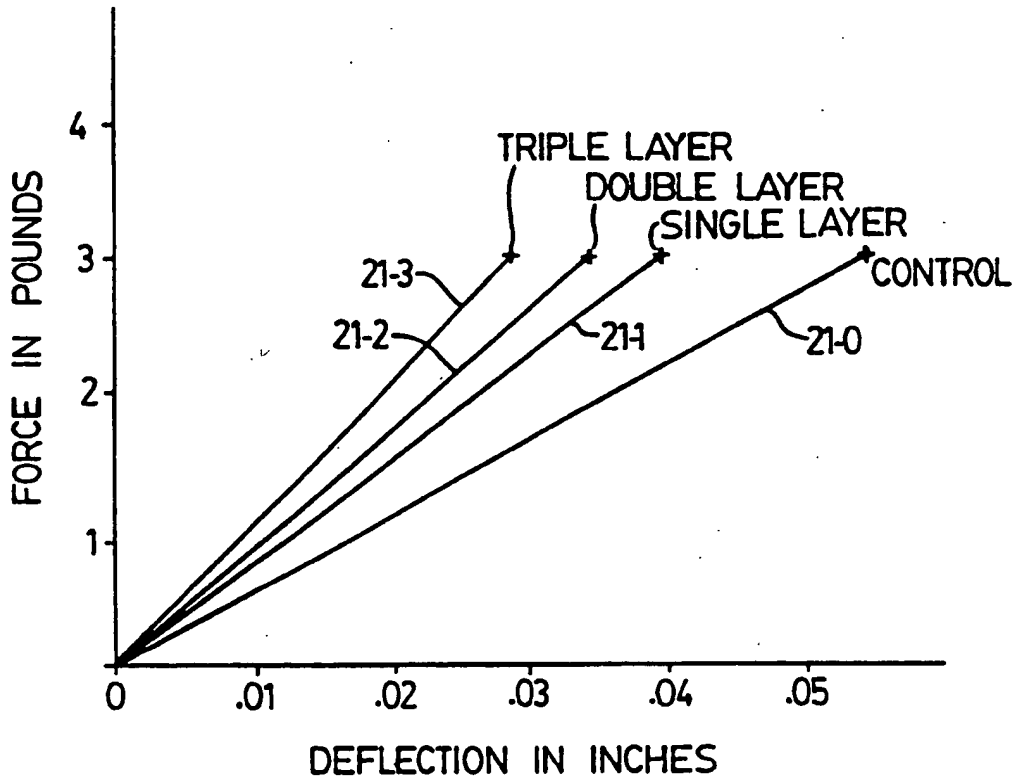
FORCE IN POUNDS
4
3
2
1
0
.01
.02
.03
.04
.05
DEFLECTION IN INCHES
TRIPLE LAYER
DOUBLE LAYER
SINGLE LAYER
CONTROL
21-3
21-2
21-1
21-0

FIG. 4

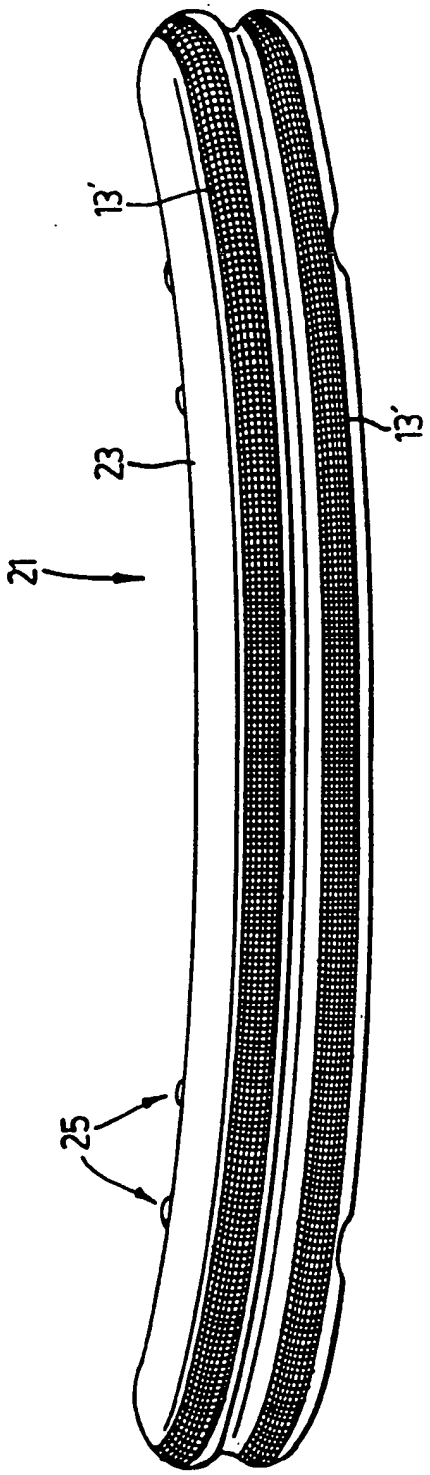

FIG. 5

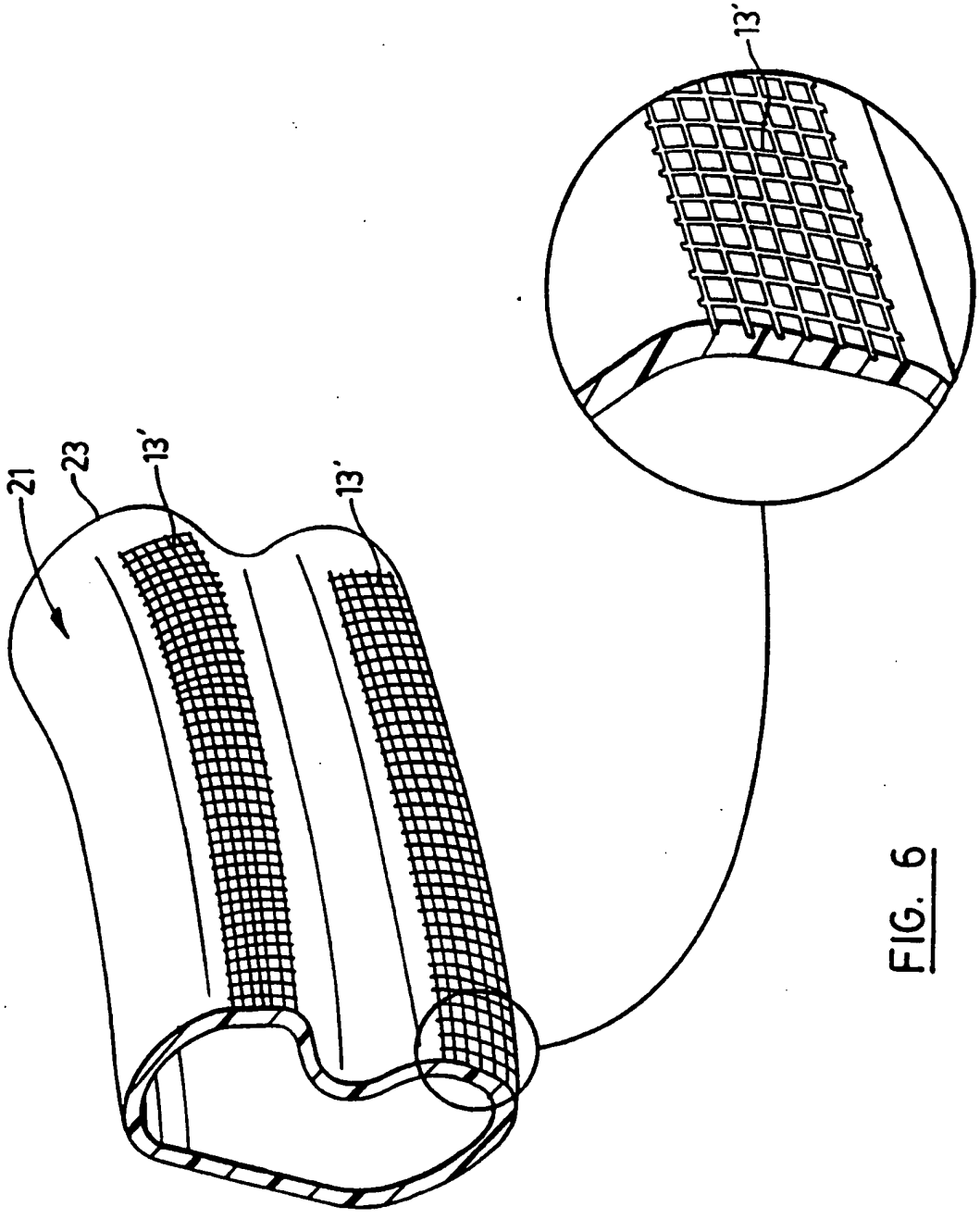

FIG. 6

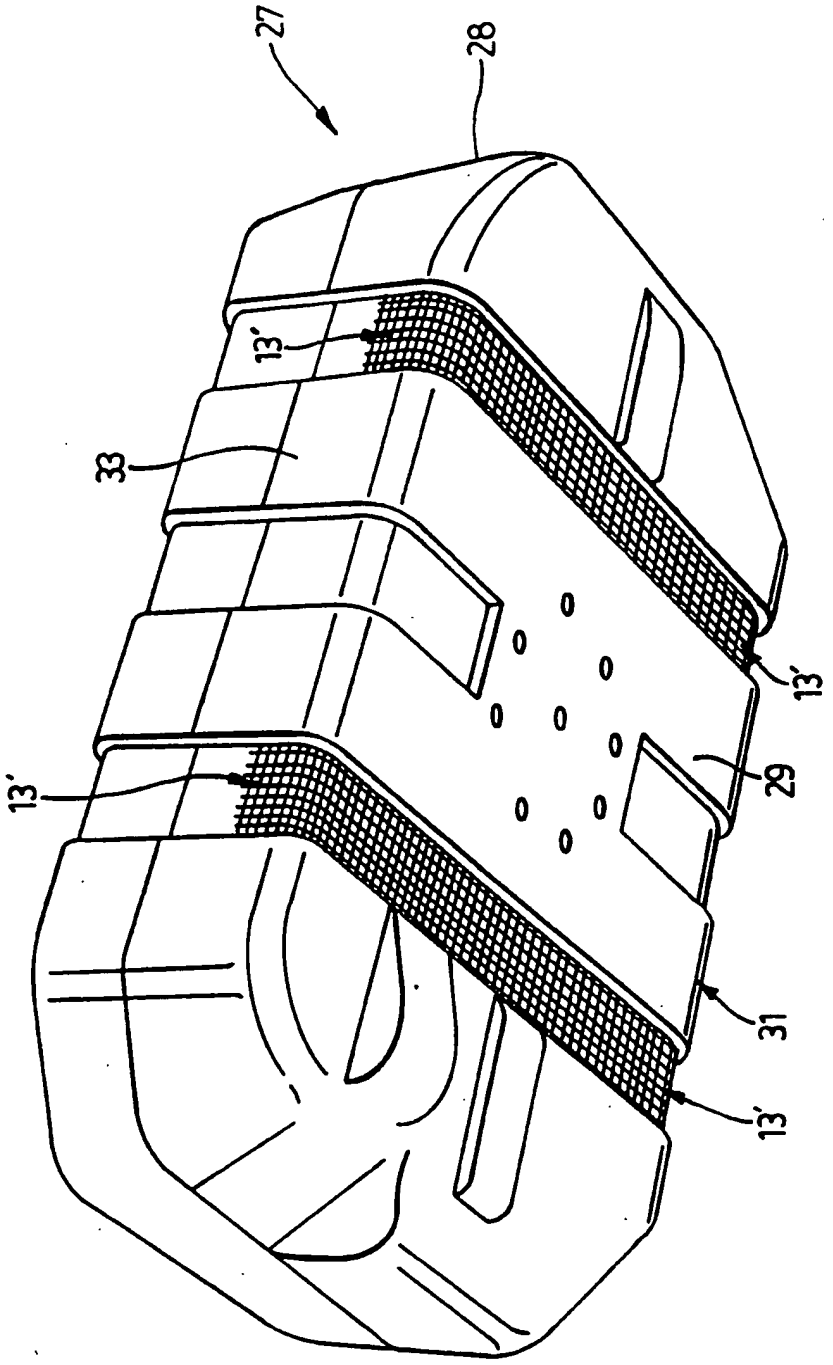

FIG. 7

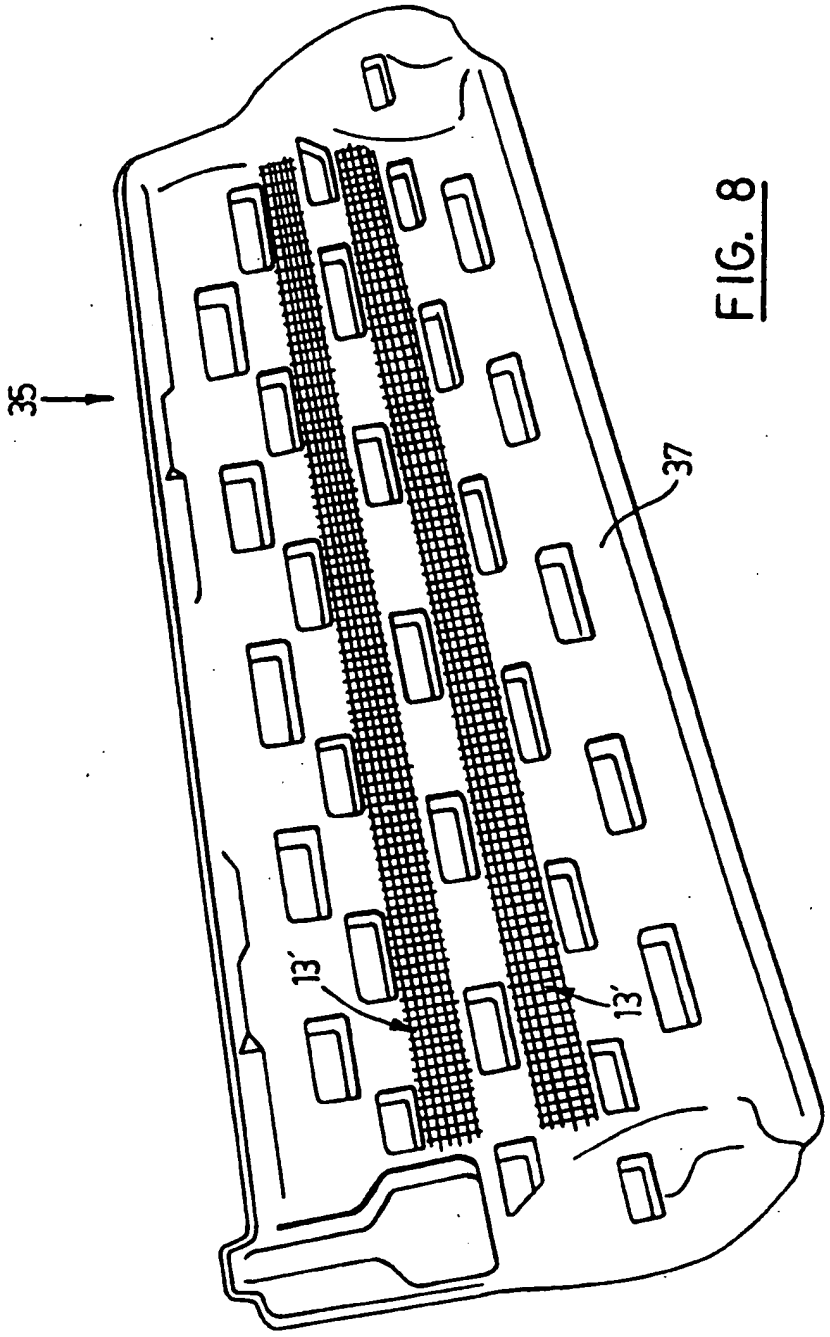

FIG. 8

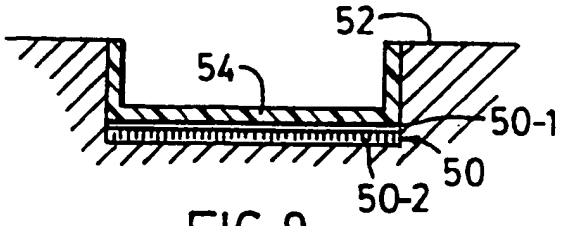

FIG. 9

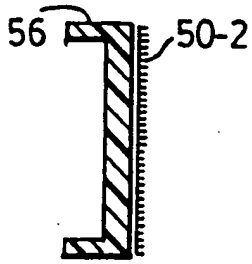

FIG. 10

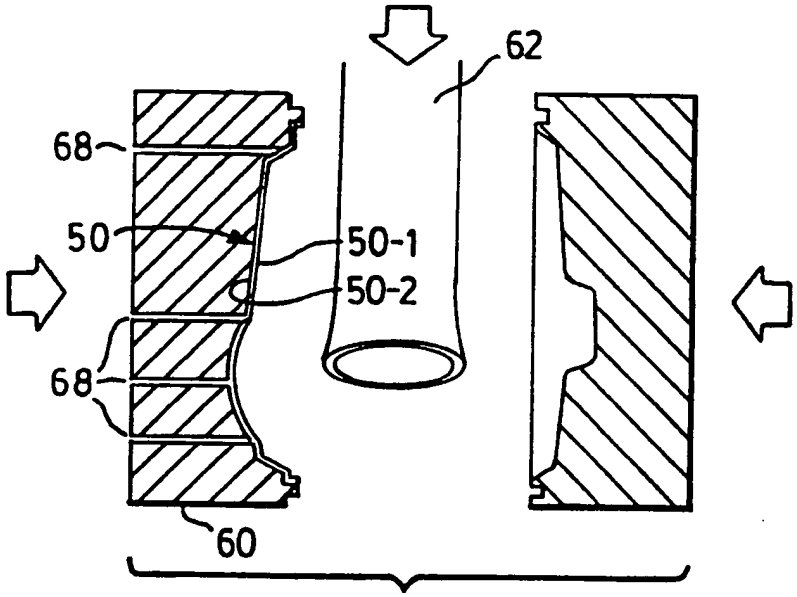

FIG. 11a

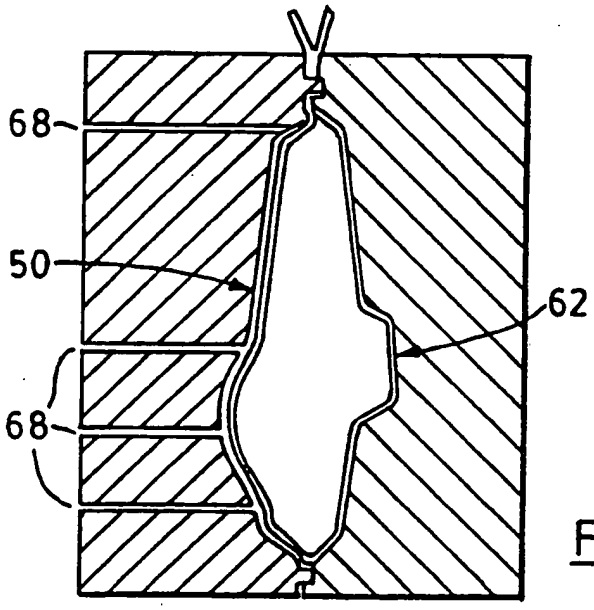

FIG. 11b

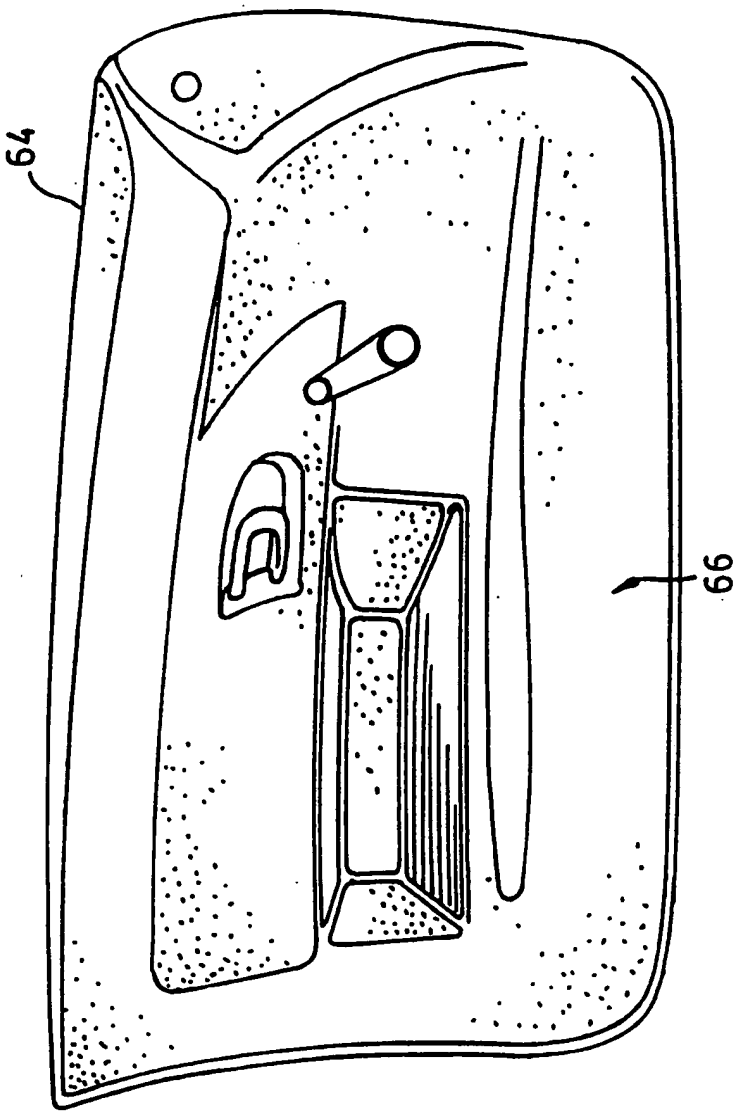

FIG. 12

International Application No
PCT/CA 93/00499

A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 B29C49/20 B29C49/24 B29C67/14 //B29L31:30,B29L31:58

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 5 B29C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB,A,1 265 142 (HARCOSTAR LTD.) 1 March 1972 see the whole document ---	1-7, 12-14, 18,19
X	GB,A,2 229 392 (ROVER GROUP LTD.) 26 September 1990 see page 6, line 15 - page 7, line 16; figures 1-4 ---	1,3,4, 12-14
X	DATABASE WPI Section Ch, Week 8512, Derwent Publications Ltd., London, GB; Class A32, AN 85-071613 & JP,A,60 025 717 (SHIN KOBE) 8 February 1985	1,4,12, 14
Y	see abstract and figures ---	17
	-/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
18 January 1994	04 -03- 1994

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	FREGOSI, A

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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X	US,A,5 020 687 (R. D. SEIZERT) 4 June 1991 see the whole document	1-4, 12-14, 16,18
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X	FR,A,1 452 273 (F. ARMBRUSTER ET AL.) 9 September 1966 see page 2, column 1, line 32 - page 2, column 2, line 23; figures 1,2 see claims 1A,1B	1-3,12, 13,18
X	FR,A,2 214 576 (G. VARTERESSIAN) 19 August 1974 see page 1, line 21 - line 23 see page 2, line 7 - line 16 see figures 4-6	1,3,4, 12-14
X	EP,A,0 148 103 (THE GOODYEAR TIRE & RUBBER COMP.) 10 July 1985 see the whole document	12-14, 16,18
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DATABASE WPI Week 8625, Derwent Publications Ltd., London, GB; AN 86-157954 & JP,A,61 089 025 (TOYODA GOSEI K. K.) 7 May 1986 see abstract and figures ---	5-9
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FR-A-2396666	02-02-79	NONE	